

Mine Rescue Ensembles Research

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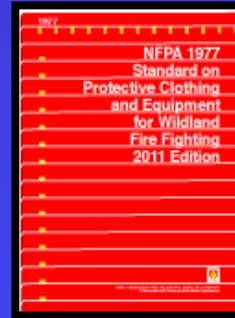
Personal Protective Technology Stakeholder Meeting

Presentation Overview

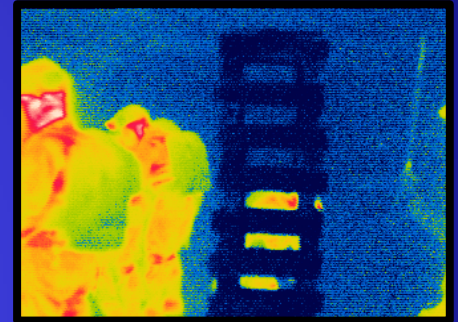
History/Background



Standards/Regulations



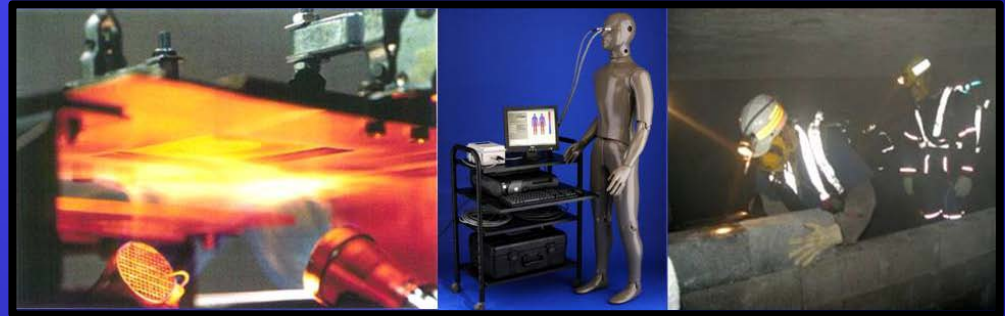
Recent Research



Field Study Results



NPPTL Project



Tragedies in the U.S. Involving Mine Rescue Teams

1869 - Avondale Mine, PA - fire blocked exit

Fatalities: 108 miners & 2 mine rescuers

1976 - Scotia Coal Mine, KY - gas and dust explosion

Fatalities: 15 miners & 11 mine rescue team members

2007 - Crandall Canyon Mine, UT - coal outbursts

Fatalities: 6 miners, 2 rescuers & 1 inspector

Injuries: 6 mine rescue team members & 1 inspector

The First Formal Mine Rescue Teams were Organized and Trained in 1900



Dr. Holmes, 1st director of United States Bureau of Mines, inspects mine rescue team members



Early mine rescue team

Provisions of the MINER Act were Intended to Improve the Mine Rescue Service

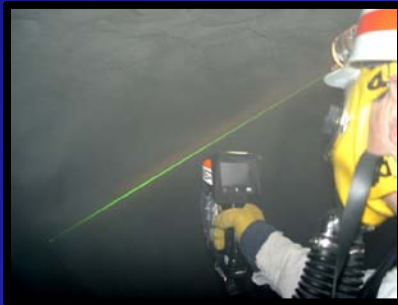
- Establish a competitive **grant program** for new mine safety technology to be administered by **NIOSH**
- Promote use of **equipment and technology** that is currently available
- Establish an **intragency working group** to provide a formal means of sharing non-classified technology that would have applicability to mine safety
- Direct the Secretary of Labor to **require wireless two-way communications** and electronic tracking systems, permitting those on the surface to locate persons underground
- Require each **mine's emergency response plan to be continuously reviewed, updated and re-certified by MSHA every 6 months**

Personal Protective Clothing Worn by Mine Rescue Teams has no Minimum Requirements or Nationally Recognized Consensus Standards



- MSHA:
 - Regulates the PPE of miners/mine rescue personnel
 - Accepts non-MSHA product safety standards
 - CFR 42 Part 84 addresses NIOSH certification requirements for respiratory protection devices
 - Requires compliance with CFR 30 Part 49 – Mine Rescue Teams, which covers mandatory types of equipment, equipment maintenance, team membership and training
 - **CFR 30 Part 49 does not specify requirements for the the clothing elements of the ensemble used by mine rescue teams**
- ANSI/ISEA Z89.1-2009, Type I, Class G contains requirements for helmets used in mine rescue

Recent Research on Mine Rescue Ensembles and Physiological Issues



- Many studies on respirators, communication devices, thermal & infra-red imagers, and training of mine rescue teams
- Limited research on ensembles for mine rescue teams
- Some studies on fire brigade teams & heat stress/heat strain issues of miners, mine rescue teams and firefighters

Recent Research on Physiological Issues

- Microclimate cooling garments
- Climatic exposure for members of mine rescue brigades while they wore flame protective clothing
- Mechanical and energy expenditure characterization of standard mining tasks
- Survey of the environmental conditions in mines
- Laboratory simulation of the tasks under controlled conditions
- Acclimation studies
- Instrumentation evaluation

NPPTL Mine Rescue Ensemble Project

Goal:

To help develop the minimum design and performance criteria for protective clothing and PPE used for mine rescue



Elements of A Typical Mine Rescue Ensemble



Weights approximately 50 pounds

Series of Steps to this Research Project



Step 1 (field study)

- Investigate mine rescue teams needs to determine specific hazards faced by mine rescue team members during an emergency operation



Step 2 (field study continued)

- Identify current products in use or products that could be used



Step 3

- Determine the specific properties associated with PPE that can be assessed or measured for providing protection against the specific hazards



Step 4

- Select available test methods that can assess or measure the specific properties identified in step 3

Series of Steps to this Research Project



Step 5

- Establish a project test plan to evaluate the products identified in step 2 using the methods selected or modified in step 4



Step 6

- Carry out the project test plan and analyze the findings to determine the best PPE combinations consistent with the user requirements



Step 7

- Prepare recommended minimum design assessment and performance criteria and submit recommendations to Standards Committees



Step 8

- Document study findings in a report that is suitable for presentation to standards committees

Field Study Findings (2009 - 2010)

- Identification of use & needs to determine specific hazards faced by mine rescuers
- Observation of over **100 teams (approximately 50% of all underground coal mine rescue teams)** at national & local mine rescue competitions and trainings Teams:
 - **Geographically covering different parts of the U.S.**
 - **State, federal, & private coal company teams**
- The number of underground coal mine rescue teams
 - **197 in 2008**
 - **217 in 2009**
- Increase is possibly due to the one hour response time and other requirements in the 2006 Miner Act

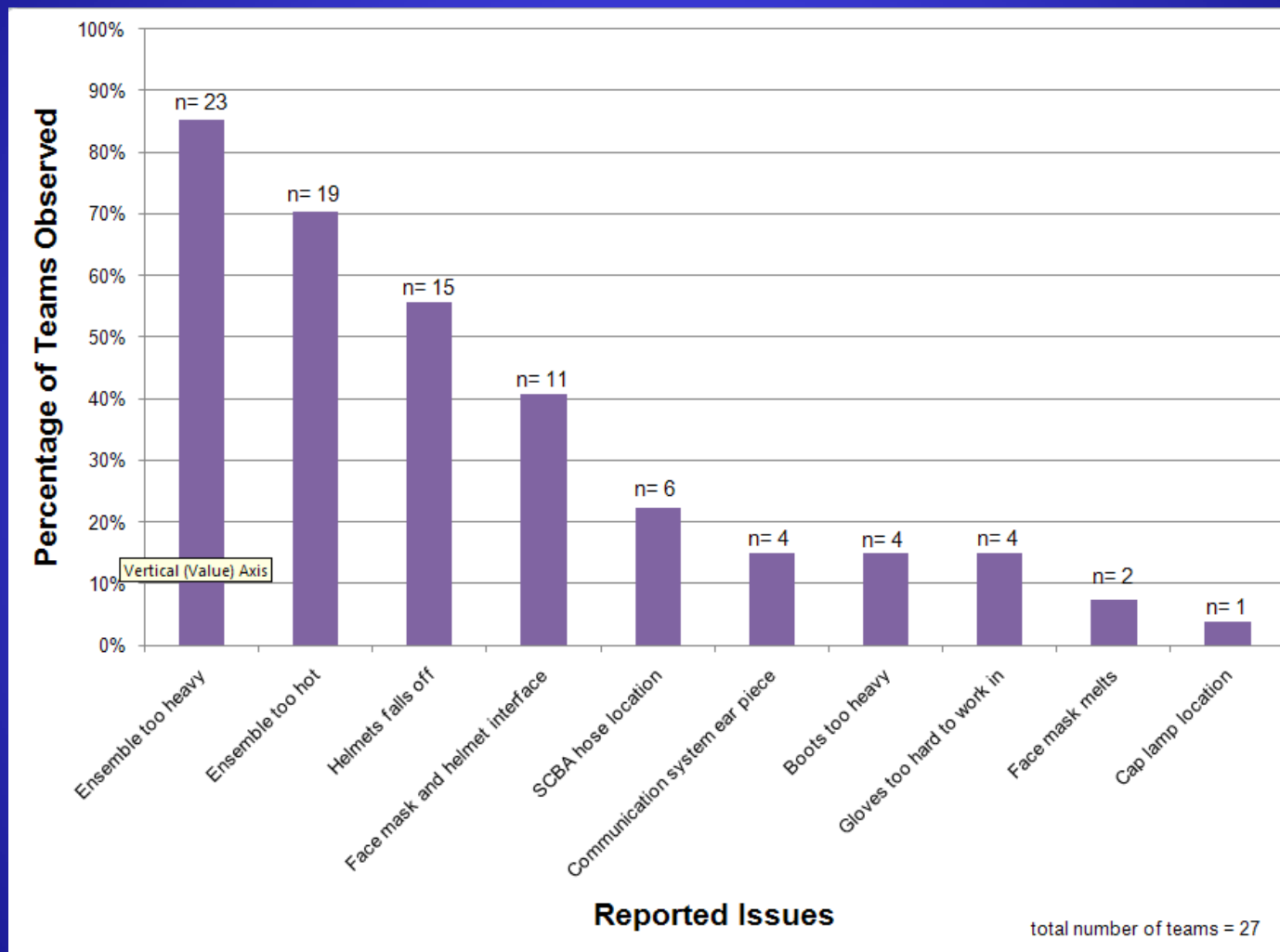


Field Study Findings (2009 - 2010)

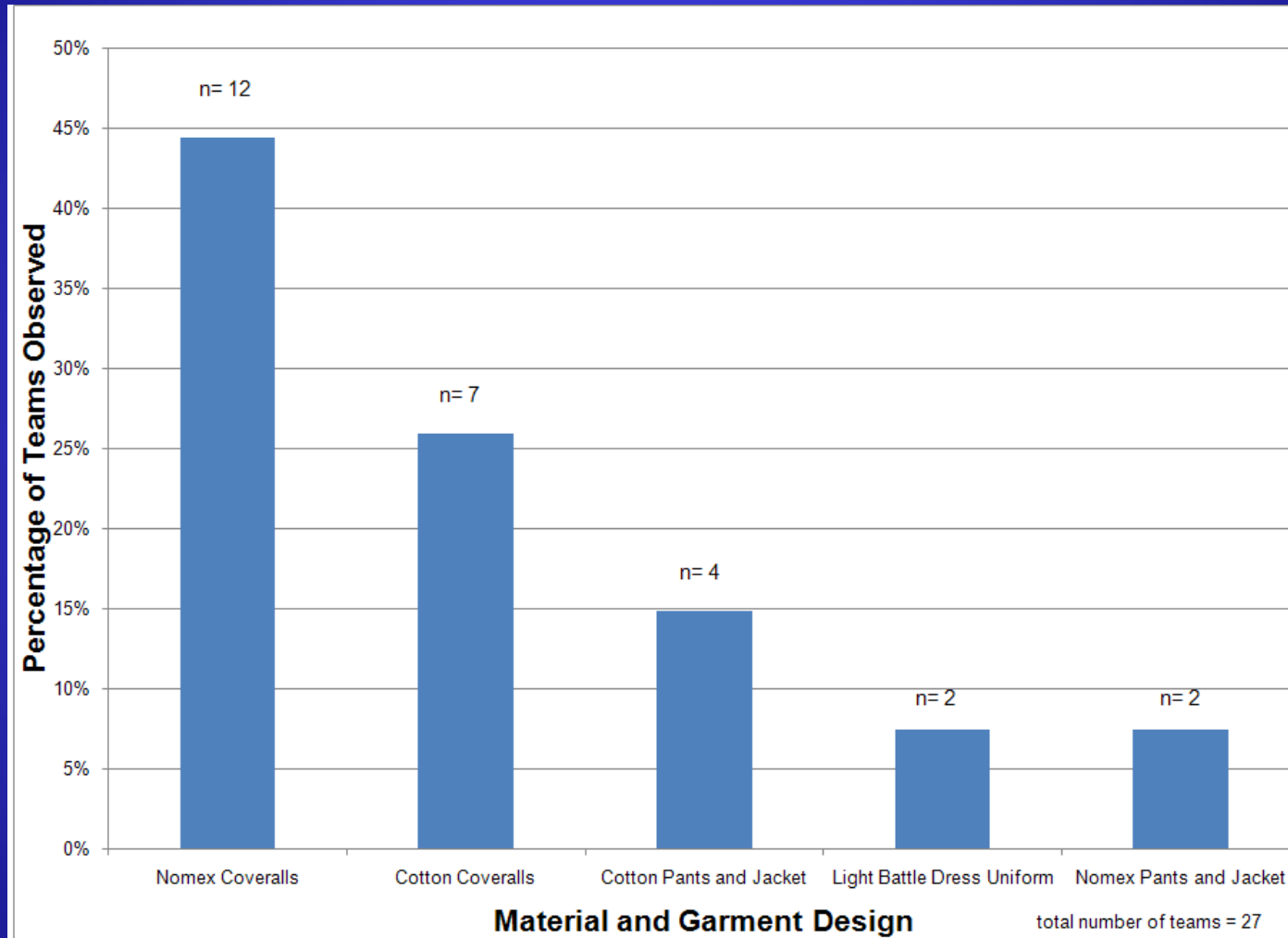
- PPE practices for mine rescue teams differ by:
 - Type of operation (fire fighting, rescue & recovery)
 - Type of organization (federal, state, & private)
- Lack of best practice documents or recognized consensus standards
- Use of different levels of protection (regular cotton/polyester work clothes to fire fighter turnout gear)
- Use of different integrated elements (helmets, hoods, cap lamps, gloves, and boots)



Field Study Observations – Issues with Current Mine Rescue Ensembles

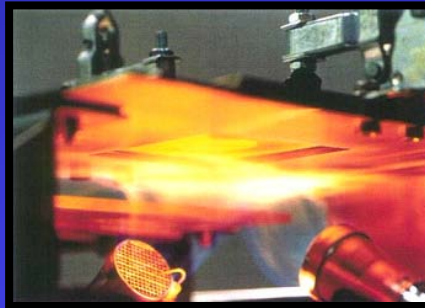


Field Study Observations – Current Material and Garment Design Usage



Project Test Plan

Phase I: Bench-scale testing



Phase II: Whole garment manikin testing



Phase III: Human subject testing



Project Test Plan

- **Phase I: Bench-scale Testing**

- The performance testing of the most commonly used elements of mine rescue ensembles
- Test methods: Methods specified in NFPA, ASTM, & AATCC standards

- **Phase II: Whole Garment - Manikin Testing**

- Evaluation of thermal insulation and evaporative resistance properties of the most commonly used ensembles
- Test methods: ASTM F1291-05 & ASTM F2370-05

- **Phase III: Human Subject Testing**

- Evaluation of the performance of mine rescue ensemble clothing material & design combinations used in Phase II
 - Anthropometric
 - Range of motion (ROM)
 - Ergonomic measurements with an additional focus on the interoperability

Intended / Potential Use of Findings

- Disseminate through journal publications, trade magazines, and stakeholder meetings
- Broaden the acceptance of mine rescue protective clothing and equipment
- Help to develop new standard or best practice documents
- Share the findings to help manufacturers design better products
- Share findings with rescue teams to help them purchase appropriate products
- Help identify additional research needs to improve mine rescue ensembles

Summary

NIOSH is currently undertaking a research project to develop the minimum design and performance criteria for protective clothing and PPE used for mine rescue

Disclaimer:

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.

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